5.4.4 WATER DELIVERY SYSTEM LOSS AND LEAKAGE REDUCTION

Throughout the state, urban retailers deliver water via pressurized pipelines to numerous residential and CII users. These pipelines are made of ductile iron, metal, concrete, plastic, or a combination of materials and are of various sizes and in a variety of working conditions. For the most part, urban water supplier maintenance and replacement programs tend to correct the worst conditions, but with many systems placed underground more than 50 years ago, and often during the 1930s and 1940s, many leaks still exist. In some instances, this can result in the loss of significant amounts of potable water, water otherwise available for meeting urban demands.

Leaks, the most common form of system losses, may be caused by several factors, including:

- Corrosion of pipe materials
- Faulty installation
- Natural events, such as earthquakes and land subsidence
- Aging water control structures

Current estimates place average unaccounted water in the various regions of the state between 6 and 15% of system deliveries. However, the amount varies significantly among urban suppliers, with some experiencing losses as high as 30% and others with less than 5%. Two percent is attributed to unmetered water use (including water used for construction, fire fighting, and flushing drains and hydrants) and meter errors; therefore, distribution system losses range between 4 and 13% (DWR 1998). CALFED has assumed for purposes of this estimate that reduction below 5% of system deliveries is cost prohibitive and technically difficult and therefore becomes the limit of conservation potential. With several hundred miles of pressurized pipeline for each utility, maintenance activities are continuous and new leaks arise as old ones are repaired, resulting in a loss constantly occurring somewhere in the system.

Current Funding Programs

For the past two decades, DWR has administered several programs to provide loans to local urban water suppliers for replacement of old, leaky systems. The programs include:

- ***Proposition 25—The Clean Water Bond Law of 1984*** - This program authorized the sale and issuance of $325 million in state bonds. Water conservation loans administered by DWR comprised $10 million of the total. This money was used to provide low-interest loans to aid in the conduct of voluntary, cost-effective capital outlay water conservation programs, including system leak reduction.

- ***Proposition 44—The Water Conservation and Water Quality Bond Law of 1986*** - This program authorized the sale and issuance of $150 million in state bonds. DWR was responsible for administering low-interest loans using about half of this funding. These loans were available for cost-effective capital outlay water conservation programs, including system leak reduction.

- ***Proposition 82—The Water Conservation Bond Law of 1988*** - This program authorized the sale and issuance of $60 million dollars that was available for cost-effective capital outlay water conservation programs, including system leak reduction.

These programs have resulted in substantial improvements in local urban distribution systems and have generated water savings of about 60 TAF annually.

Projected Conservation under the No Action Alternative

Minor reductions in distribution system losses will continue to occur regardless of the outcome of the CALFED Program. Through continuation of loan programs, mostly administered by DWR, and increasing focus by local agencies on the destination of their water, CALFED has assumed that system loss reductions potentially decreases a percent on average throughout many of the water districts in the state. However, several regions are believed to already have reduced system losses to 7%, leaving only slight reductions feasible before reaching CALFED's assumed practical limit. For these regions, reductions under the No Action Alternative condition are assumed to result in average regional system losses of 6%. Table 5-6 presents CALFED's assumed levels of reduction.

Estimates of potential savings were calculated based on an estimate of baseline distribution system conditions and future water delivery quantities. Because conservation estimates are regional, estimates of regional system loss conditions, not per-district conditions, were needed. Data from DWR regarding existing urban "unaccounted" delivered water was obtained and adjusted downward by 2% to account for unmetered water and meter errors (DWR1997) (see Table 5-6). The results for each region are shown under the regional discussion later in this section.

Reduction estimates were calculated by taking the difference in the baseline percentage and the assumed No Action Alternative savings, multiplied by the projected urban use for each particular region (2020 per-capita use multiplied by the projected population; see Table 5-2 and Figure 5-4).

To illustrate this method, consider:

For Region X:

Assume:	Baseline loss	=	9%
	No Action Alternative condition	=	7%
	2020 per-capita use	=	200 gpcd
	2020 population	=	TAF
Calculations:	Projected urban use	=	224,000 acre-feet [gpcd * population]
	Projected loss	=	20,000 acre-feet[224,000 * 9%]
	Saving potential	=	224,000 acre-feet * (9%-7%)
		=	4,480 acre-feet

Additional Conservation as a Result of the CALFED Program

Additional reduction in system losses are anticipated to occur as a result of the CALFED Program's additional assistance and funding programs, as well as assurance mechanisms designed to ensure that high levels of water use efficiency are being achieved. As previously stated, CALFED assumed that distribution system losses could be lowered to 5% of system deliveries. Table 5-6 shows how the 5% value relates to each region's assumed No Action Alternative condition.

Limiting the reduction potential to 5% assumes continuation of pipeline wear and breakage that will occur regardless of the time and effort spent trying to prevent it or to immediately correct it. Obtaining system losses of less than 5% is also technically limited by reduced ability to detect leaks in plastic pipes, the latest pipeline material to be used for urban water distribution systems. Although this material is less likely to corrode, cracks or breaks, which inevitably will occur, are difficult to detect when compared to iron or clay.

The same method used to calculate potential No Action Alternative savings was used to calculate incremental CALFED reductions. The difference between the assumed No Action Alternative system loss percentage and that assumed for CALFED formed the basis. Results are presented under the regional discussions.

Table 5-6. Assumed Levels of System Distribution Losses (Percent of Total Demand)

REGION[1]	BASELINE CONDITIONS[2]	2020 NO ACTION ALTERNATIVE CONDITIONS	2020 WITH *CALFED CONDITIONS*
Sacramento River	7	6	5
Eastside San Joaquin River	7	5	5
Tulare Lake	7	6	5
San Francisco Bay	6	6	5
Central Coast	8	7	5
South Coast	7	6	5
Colorado River[3]	12	8	5

1 Refer to Chapter 3 for information regarding the PSAs that comprise each CALFED region.

2 Existing percentage values are compiled from data submitted to DWR by many water agencies throughout the state. Values do not include unmetered water or meter errors, both of which are not considered distribution system losses (DWR 1997).

3 This region is assumed to have a high existing condition and is expected to make greater progress in reducing system losses under the No Action Alternative than is assumed for the other regions (4% versus 1%).

5.5 IRRECOVERABLE LOSSES VS. RECOVERABLE LOSSES

Similar to characteristics of water losses in agriculture, losses associated with urban water use can be characterized as resulting in irrecoverable or recoverable losses. Refer to the discussion in Section 4.4, "Irrecoverable vs. Recoverable Losses," for a more detailed explanation of this issue.

All urban water losses from landscaping, CII, and residential uses either directly or via a wastewater treatment plant return to surface water or groundwater bodies and may be recoverable. In theory, all losses are recoverable. In practice, however, losses that flow to very deep aquifers or excessively degraded water bodies may not be recoverable because of prohibitively expensive energy requirements (that is, they become irrecoverable). Determining recoverability varies with location and time, as well as other factors (DOI 1995).

Distinguishing irrecoverable and recoverable losses typically depends solely on water quality considerations. This assumes that all losses to usable water bodies can be economically recovered. Principal water bodies that are regarded as irrecoverable include saline, perched groundwater underlying irrigated land on the west side of the San Joaquin Valley; the Salton Sea, which receives urban wastewater from the Coachella and Imperial Valleys; the San Francisco Bay; and the ocean.

Real water savings can be achieved only by reducing irrecoverable losses because that water is truly lost from the system. Water is considered "saved" when these losses are reduced. However, while the reduction of urban nonconsumptive use does not generate a new supply of water, the conserved water could be available to meet projected increases in local demand.

Recoverable losses, on the other hand, often constitute a supply to the downstream user. Downstream uses can include groundwater recharge; agricultural and urban water use; and environmental uses, including wetlands, riparian corridors, and in-stream flows. Often, recoverable losses are used many times over by many downstream beneficiaries. To reduce these losses would deplete such supplies with no net gain in the total water supply. Their reduction, however, provide significant opportunities to contribute to the achievement of other CALFED objectives, such as:

- Improving instream water quality through reduced runoff of water laden with residual landscape chemicals and other urban toxins that can flow into storm drains.

- Reducing temperature impacts resulting from resident time of wastewater during treatment process.

- Reducing entrainment impacts on aquatic species as a result of reduced diversions, and

- Reducing impacts on aquatic species, especially anadromous fish, through minor modifications in diversion timing and possibly providing in-basin benefits through subsequent modifications in the timing of reservoir releases.

5.6 REGIONAL CONSERVATION ESTIMATES

Estimates of the results of efficiency improvements are presented here for each of the agricultural regions defined previously in Section 3, "Determination of Geographical Zones." The values presented are to help understand the potential role conservation could play in the larger context of state-wide water management, as well as to provide information for purposes of a programmatic level impact analysis. **These estimates provide our best estimate of the potential for urban conservation but are not goals and targets and are not intended to be used for planning purposes.** Estimates of potential reduction in urban demand are presented under one of two categories:

- Estimated reduction in total loss (other than the "irrecoverable loss" portion, only available to provide water quality and ecosystem benefits, and potentially reduce future demand projections of a particular basin).
- Estimated reduction in irrecoverable losses (available to reallocate to other beneficial water supply uses).

For each urban region, the following tables are presented: assumed distribution of landscaped acreage among ET_o factors, potential conservation of existing losses (including irrecoverable loss), and potential conservation of irrecoverable losses (available for reallocation). This information is included in Tables 5-7a through 5-14c.

Estimated reduced irrecoverable losses can be viewed as a source of water for reallocation to other purposes, such as improved local supply reliability; offsetting local groundwater overdraft; or a transfer to other beneficial water supply uses, including the environment. Reduction of loss that is not defined as irrecoverable is not available for reallocation to out-of-basin water supply purposes but can provide significant benefits to water quality and ecosystem health as well as improving local water supply reliability.

It is important to note that potential loss reductions in the Colorado River Region would not directly translate to water quality or ecosystem benefits in the Bay-Delta watershed. Similarly, reduction of losses in regions that import water from the Bay-Delta but are not tributary to the Delta (South Coast, Central Coast, and San Francisco Bay Regions) can only provide an ecosystem benefit through reductions in diversions or modified diversion timing. Their ability to provide water quality benefits is limited because wastewater treatment plant return flows, a primary source of degradation, from these regions do not re-enter the Delta watershed. Therefore, reduced urban use that reduces wastewater flows does not provide a Bay-Delta benefit. Other export areas whose return flows do re-enter the Bay-Delta watershed can provide water quality as well as ecosystem benefits.

5.6.1 UR1 - SACRAMENTO RIVER

The Sacramento River Region is defined by the Sacramento Valley, from Sacramento north to Redding. The area is predominantly in agriculture, but many growing communities are within its boundary, including the greater metropolitan areas of Sacramento. All rivers that flow into the valley are carried by the Sacramento River southward to the Delta. Here, surface flows head west to the Pacific Ocean. With abundant surface and groundwater resources, urban users in this region experiences few water shortages. Sacramento Valley water users possess some of the oldest rights to surface water, with some rights dating back to the Gold Rush era. Urban water use comprises only about 6% of the region's total water use. The more populated urban areas are located on the valley floor, where summer temperatures over 100 degrees are not uncommon.

The region is characterized by largely single-family dwellings with relatively large landscapes, numerous processing and packing facilities for agricultural products, and limited manufacturing industry. For its size, the Sacramento River Region is sparsely populated, with an average density of fewer than 90 people per square mile. Most of these people live in the southern end of the region in and around Sacramento.

Typically, nonconsumptive urban water use, such as indoor residential use and losses associated with landscape irrigation, tend to return to the system of rivers, streams, and aquifers. Water applied to the landscape in excess of landscape water requirements usually flows to the storm channels via paved gutters and back to the surface waters. Likewise, after treatment, industrial and municipal indoor water use also ends up in the surface waters and is available for subsequent reuse. The region does not experience significant irrecoverable losses, although water quality degradation does occur.

The potential for reduction of irrecoverable losses exists through the reduction in landscape water use and any potential reduction in consumption associated with commercial or industrial uses. Otherwise, conservation measures can primarily provide water quality, ecosystem, and timing and energy savings benefits, as well as potentially reducing future need for more water supply development.

Urban populations are expected to grow significantly in the next 20 years, primarily around the greater Sacramento metropolitan area.

In this region, 21 urban agencies have signed the Urban MOU.

URBAN INFORMATION
Sacramento River Region

	Population	*Baseline per-capita water use*
1995:	2.4 million	274 gpcd
2020:	3.9 million	257 gpcd (292 if no conservation occurs)

Approximate CII use in 1995:	35% of per-capita use
Estimated CII use in 2020:	36% of per-capita use
Assumed CII reduction as a result of conservation measures:	
No Action Alternative:	4% (of 2020 projected per-capita water use)
CALFED:	7%
Assumed residential indoor use (average):	
2020 baseline	65 gpcd
2020 No Action Alternative	60 gpcd
2020 CALFED	55 gpcd
Assumed distribution system losses (as a percent of 1995 total urban use):	
Existing:	7%
No Action Alternative:	6%
CALFED:	5%
Assumed ratio of irrecoverable losses to total existing loss:	0.05 (5%)
Assumed existing urban landscape acreage:	100,000 acres
Assumed urban landscaped acreage in 2020:	145,000 acres
Assumed ET_0 Value:	4.2 feet of water annually

Estimated Reduction in Irrecoverable Losses for Reallocation to Other Water Supply Uses

As discussed above, the Sacramento River Region is characterized as having significant amounts of incidental reuse, especially of indoor residential water. Most indoor use returns to local surface streams and rivers after treatment and is relied on as part of downstream flows. In addition, changes in the type of outdoor landscaping are assumed to result in only negligible savings. The region has little potential water savings that can be reallocated to other beneficial uses. It is true, however, that potential exists to implement urban conservation measures for other purposes, namely improved water quality, changed timing of flow releases, reduced fishery impacts, reduced treatment costs, and potentially reduced need for additional water supply development. These benefits primarily relate to the savings shown in Table 5-7b.

Table 5-7a. Assumed Distribution of Landscaped Acreage among ET_o Factors for the Sacramento River Region (%)

			2020 NO ACTION		2020 CALFED	
ET_o FACTOR	**1995 ACRES (%)**	**BASE ACRES (%)**	**EXISTING ACRES (%)**	**NEW ACRES (%)**	**EXISTING ACRES (%)**	**NEW ACRES (%)**
1.2	100	100	50	30	40	10
1.0			25	30	30	10
0.8			25	40	30	75
0.6						5
0.4						

Table 5-7b. Potential Conservation of Existing Losses (Including Irrecoverable Loss) for the Sacramento River Region (TAF/Year)

USE	PROJECTED REDUCTION UNDER NO ACTION ALTERNATIVE	INCREMENTAL REDUCTION UNDER CALFED	TOTAL ESTIMATED REDUCTION
Residential indoor[1]	20-25	20-25	40-50
Urban landscaping[1]	100-105	30-35	130-140
Commercial, industrial, institutional[1]	15-20	25-30	40-50
Distribution system[1]	10-15	10-15	20-30
Total	**145-165**	**85-105**	**230-270**

[1] For this region, it is assumed that 95% of all losses are recovered and available to the local water supply.

Table 5-7c. Potential Conservation of Irrecoverable Losses (Available for Reallocation) for the Sacramento River Region (TAF/Year)

USE	PROJECTED REDUCTION UNDER NO ACTION ALTERNATIVE	INCREMENTAL REDUCTION UNDER CALFED	TOTAL ESTIMATED REDUCTION
Residential indoor[1]	1-2	1-2	2-4
Urban landscaping[1,2]	4-5	2-4	6-9
Commercial, industrial, institutional[1]	0-1	1-2	1-3
Distribution system[1]	0-1	0-1	0-2
Total	**5-9**	**4-9**	**9-18**

[1] For this region, it is assumed that only 5% of all loss reduction is available for reallocation.

[2] Urban landscaping values include both reduction in losses and changes to landscaping types. See Attachment B for more details on landscape conservation estimates.

5.6.2 UR2 - Eastside San Joaquin River

The Eastside San Joaquin River Region encompasses the area from the San Joaquin River near Fresno north to the Cosumnes River, and from the eastern foothills to the San Joaquin River as it travels up the valley to the Delta. This area is predominantly agricultural but includes the metropolitan areas of Stockton, Modesto, and Merced along with numerous other communities. Several rivers originating in the Sierra Nevada flow out of the mountains and west into the San Joaquin River (as it travels through the center of the valley). These include the Merced, Tuolumne, Stanislaus, and Mokelumne Rivers as well as other small tributaries. Urban water use comprises only about 5% of the region's total water use. The more populated urban areas are located on the valley floor, where summer temperatures over 100 degrees are not uncommon.

With abundant surface water and groundwater resources, urban users in this region experience few water shortages. However, most of the urban communities in the region rely heavily on groundwater for municipal supplies. Recently, some agricultural irrigation districts in the region are developing agreements that would allow them to provide surface water to these communities as a supplemental source to the current groundwater supplies.

The region is characterized by largely single-family dwellings with relatively large landscapes, numerous processing and packing facilities for agricultural products, and limited manufacturing industry. The region has an average population density of just under 200 people per square mile. Most of these people are concentrated in the urban towns and cities.

Typically, non-consumptive urban water use, such as indoor residential use and losses associated with landscape irrigation, tend to return to the system of rivers, streams, and aquifers. Water applied to the landscape in excess of landscape water requirements usually flows to the storm channels via paved gutters and back to the surface waters. Likewise, after treatment, industrial and municipal indoor water use also ends up in the surface waters and is available for subsequent reuse. The region does not experience significant irrecoverable losses, although water quality degradation does occur.

The potential for reduction of irrecoverable losses exists through the reduction in landscape water use and any potential reduction in consumption associated with commercial or industrial uses. Otherwise, conservation measures can primarily provide water quality, ecosystem, and timing and energy savings benefits, as well as potentially reducing future need for more water supplies.

Urban populations are expected to grow significantly in the next 20 years, primarily around the cities of Stockton, Modesto, and Merced. These areas increasingly serve as "bedroom communities" for the Bay Area.

In this region, six urban agencies have signed the Urban MOU.

URBAN INFORMATION
Eastside San Joaquin River Region

	Population	*Baseline Per-capita water use*
1995:	1.6 million	301 gpcd
2020:	3.1 million	269 gpcd (306 if no conservation occurs)

Approximate CII use in 1995:	24% of per-capita use
Estimated CII use in 2020:	25% of per-capita use
Assumed CII reduction as a result of conservation measures:	
No Action Alternative:	4% (of 2020 projected per-capita water use)
CALFED:	07%
Assumed residential indoor use (average):	
2020 baseline	65 gpcd
2020 No Action Alternative	60 gpcd
2020 CALFED	55 gpcd
Assumed distribution system losses (as a percent of total urban use):	
Existing:	7%
No Action Alternative:	6%
CALFED:	5%
Assumed ratio of irrecoverable losses to total existing loss:	0.05 (5%)
Assumed existing urban landscape acreage:	65,000 acres
Assumed urban landscaped acreage in 2020:	120,000 acres
Assumed ET_0 Value:	4.3 feet of water annually

Estimated Reduction in Irrecoverable Losses for Reallocation to Other Water Supply Uses

As discussed above, the Eastside San Joaquin River Region is characterized by significant amounts of incidental reuse, especially of indoor residential water. Most indoor use returns to local surface streams and rivers after treatment and is relied on as part of downstream flows. Changes in the type of outdoor landscaping are assumed to result in only negligible savings. The region has little potential water savings that can be reallocated to other beneficial uses. The potential exists, however, to implement urban conservation measures for other purposes, namely improved water quality, changed timing of flow releases, reduced fishery impacts, reduced treatment costs, and potentially reduced need for additional water supply development. These benefits primarily relate to the savings shown in Table 5-8b.